

PREPRODUCTION INITIATIVE OPTICAL ICE DETECTION SYSTEM TEST PLAN

SITE: NAS BRUNSWICK, ME

1.0 OBJECTIVE

This test plan describes the evaluation criteria and data collection procedure for evaluating the use of an optical ice detection system in a Navy operational environment. The data will be used to determine the system's efficiency, effectiveness, and overall success with respect to detecting ice, snow, and frost contamination on fixed-wing aircraft during deicing procedures. The environmental and cost benefits of an optical ice detection system versus the current visual and physical inspection procedures will be determined.

2.0 DESCRIPTION

Ice formation on aircraft surfaces substantially impairs the aircraft's ability to take off and fly. According to Air Transport Association data, as little as 1/64 of an inch of ice on the leading edge of an aircraft's wing can reduce takeoff lift by as much as 24 percent. Aside from the obvious safety implications, this reduction in lift can cause increased fuel usage and greater engine wear. To address these problems, deicing typically is performed from October through April, with certain locations in colder climates extending the deicing season.

Aircraft deicing is usually performed shortly before the aircraft is ready to taxi out for takeoff. The most common method of applying the fluid involves a specialized truck that pumps heated water and either ethylene glycol or propylene glycol (glycol) through a high-pressure spray nozzle mounted on a boom. Both water and glycol are contained in the truck's onboard tanks. The nozzle operator, who is positioned in a cab at the end of the boom, directs the spray at the aircraft by maneuvering the boom and the nozzle. The spraying continues until all of the ice and snow contamination has been removed from the aircraft surfaces. Because the deicing fluid has no lasting protective effects either by itself or when diluted with the melted contamination (it runs off the aircraft as soon as spraying stops), it is sometimes necessary to deice an aircraft several times before takeoff. This most often occurs either when the aircraft must wait between initial deicing and actual takeoff or under specific weather conditions.

Ethylene glycol and propylene glycol are water-soluble organic chemicals that have been found to adversely affect various species of wildlife and vegetation. Both are regulated by the U.S. Environmental Protection Agency (EPA) under the Clean Water Act (CWA) and the Toxic Substances Control Act (TSCA), and by various states under their environmental laws. Ethylene glycol is further regulated by the EPA under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA),

the Clean Air Act (CAA), and the Emergency Planning and Community Right-to-Know Act (EPCRA). Therefore, appropriate measures must be taken to control the discharge of deicing fluid into the environment. At NAS Brunswick, all deicing operations are conducted on a deicing pad, which captures used deicing fluid for subsequent treatment and disposal.

To reduce the costs associated with excess glycol usage and the environmental impact of deicing procedures, the Navy has been studying various aspects of the deicing process. Some efforts have been directed at finding cost-effective ways of capturing and treating or recycling glycol runoff. PPEP is interested in testing the performance of optical ice detection systems as a means of safely reducing the volume of glycol used in deicing operations.

Optical ice detection systems typically use either infrared spectroscopy or laser refractometry to detect frozen contamination on surfaces. The surface under inspection is exposed to a light source (provided either by the system or by ambient sunlight), and the system captures the light reflected from the surface. The system then compares the spectrum of the reflected light to a baseline spectrum. Differences between the spectra are used to identify areas of frozen contamination. The system then provides users with an image displaying the inspected surface and any identified areas of frozen contamination.

The IceHawk Wide Area Ice Detection System, manufactured by Goodrich Sensor Systems, was selected for demonstration under this project. The sensor unit of the IceHawk sends an infrared signal at the aircraft and captures the reflected infrared light. Differences between the sent and captured spectra are used to detect ice, snow, and frost on the aircraft. The system then provides the nozzle operator with an image of the aircraft and the location of any frozen contamination. The images are stored electronically for later use during training or accident assessment.

3.0 TEST PLAN

This test plan will be used to evaluate the effectiveness of the IceHawk manufactured by Goodrich Sensor Systems. Quantitative and qualitative data will be collected and used to evaluate the system's ability to reduce the volume of glycol used during deicing operations and reduce the time required to perform deicing operations.

3.1 Approach

One IceHawk sensor unit, two mounting systems, two control boxes, and two color LCD displays have been purchased for this project. Each of the mounting systems, control boxes, and displays will be permanently installed in either a Landoll TM-1800 deicing truck (the current Navy standard) or a Global GL-1800 (see the deicing truck currently being procured). The sensor unit will be moved between the trucks to provide comparative data. Quantitative and qualitative data will be collected by completion of

the Event Log, the Maintenance Log, and the site's current De-ice/Glycol Request Form (see attached example).

3.2 Instructions for Completing the Event Log

The Event Log is to be completed by the truck operator during each deicing event. The data required for each entry are as follows:

- **Date:** Enter the current day, month, and year.
- **Control Number:** Enter the control number from the De-ice/Glycol Request Form.
- **Aircraft BUNO:** Enter the aircraft side number.
- **Nozzle Operator:** Enter the initials of the nozzle operator.
- **Truck Operator:** Enter the initials of the truck operator.
- **Image Series Number:** Enter the series number (first part of the image serial number) of the images recorded during the deicing event.
- **Deicing Truck Used:** Check the appropriate box to indicate whether the IceHawk was mounted on a Landoll TM-1800 or Global deicing truck.
- **Flow Meter – Initial:** Record the flow meter reading before spraying begins.
- **Flow Meter – IceHawk Complete:** Record the flow meter reading after the IceHawk indicates the aircraft is clean and before any additional spraying required by the Flight Engineer (FE).
- **Flow Meter – Final:** Record the flow meter reading after the FE indicates the aircraft is clean.
- **Ice Detector Image Number:** Enter the image number (second part of the image serial number) associated with each image taken by the nozzle operator.
- **Is Ice, Snow, Frost, Etc., Visible on Aircraft?:** Check the appropriate box to indicate whether or not visible, frozen contamination was present on the aircraft at the time the image was taken.
- **Clarity of This Image:** Using a scale from 1 (worst) to 5 (best), indicate the clarity of the image provided by the IceHawk.
- **Usefulness of This Image for Deicing:** Using a scale from 1 (worst) to 5 (best), indicate how well the image provided by the IceHawk assisted in the identification of frozen contamination on the aircraft.
- **IceHawk Complete:** Indicate the image that shows the aircraft at the time the IceHawk indicates that the aircraft is clean.
- **FE Inspection of Aircraft:** Indicate the image that shows the aircraft at the time of the FE's inspection by checking the appropriate box.
- **Did FE Require Additional Deicing?:** Indicate whether the FE required additional deicing by checking "Yes" or "No."
- **Comments:** Provide any additional comments regarding the performance of the IceHawk and its interface with deicing operations. Comments should include information such as the system's ease of use, recommended improvements to the system, discrepancies noted, and factors affecting the system's performance (e.g., wind, cab movement, precipitation, etc.).

- **Flow Meter – Final:** Record the flow meter reading after the FE signs the release for the deicing event.

3.3 Instructions for Completing the Maintenance Log

The Maintenance Log should be completed whenever repair or maintenance is performed during the evaluation period. Enter the month and year in the space provided at the top of the log and respond to each question, as necessary.

Repair

If repairs are required, contact Ken Wright (UTRS) or Raymond Wendrzycki (NAVAIR Lakehurst) immediately (see Section 4.1, Points of Contact, for phone numbers). If the IceHawk or flow meter required repairs, describe the event or circumstance that resulted in the need for repair, any corrective action(s) taken, and any suggestions to prevent a recurrence.

Maintenance

On the Maintenance section of the Log, indicate whether the IceHawk or flow meter required any maintenance (e.g., cleaning, tightening of mounts, etc.). If maintenance was required, specify the necessary maintenance action and whether it was performed.

Additional Comments

Provide any additional comments regarding experience with and performance of the ice detection system during the month. Comments should include both positive and negative aspects of the system's ease of use and interface with deicing operations. In addition, provide recommendations for improvements to, tips for effective use of, and convenience of the mounting locations for the system.

4 REPORTING

CWO4 Mark Holmes has approved the use of these logs for this project. As previously described (see Section 3.2), the Event Log will be completed each time the system is used and the Maintenance Log will be completed on an as-needed basis. Data will be collected beginning in February 2005 and throughout the remainder of the 2004-2005 deicing season (approximately April 2005). During the evaluation period, the data sheets will be faxed to Ken Wright and Raymond Wendrzycki (see Section 4.1, Points of Contact, for the fax number) monthly, at a minimum. The final report will include information on the system's overall performance, cost-effectiveness, and ability to interface with site operations.

4.1 Points of Contact

If at any time during the prototype period the equipment malfunctions, or if consumables or technical support is needed, contact the assigned POC at NAVAIR Lakehurst and/or UTRS as listed below. Do not contact the vendor under any circumstances—unless there is an emergency. Do not make any repairs to the equipment yourself as this may invalidate warranties. Please discuss any ideas you may have regarding equipment modifications or improvements with NAVAIRLKE or UTRS; do not discuss your ideas with the vendor as contractual problems may arise. NAVAIRLKE and UTRS will arrange and procure all reasonable orders for consumables and repairs as soon as possible to ensure minimal impact to your site's operations. Please keep in mind that both regular communication with NAVAIRLKE and UTRS, and regular submittal of your data sheets are vital to the success of the technology demonstrations.

POC	Affiliation	Phone No.	Fax No.
Ken Wright	UTRS, Cherry Hill, NJ	(856) 667-6770	(856) 667-7586
Raymond Wendrzycki	NAVAIR Lakehurst, Lakehurst, NJ	(732) 323-1666	(732) 323-4025

ICE DETECTION SYSTEM EVENT LOG

Date: _____ Control Number: _____ Aircraft BUNO: _____

Nozzle Operator: _____ Truck Operator: _____ Image Series #: _____

Deicing Truck Used: ☐ Landoll TM-1800 ☐ Global

Flow Meter – Initial: _____ IceHawk Complete: _____ Final: _____

Ice Detector Image Number	Is Ice, Snow, Frost, Etc., Visible on Aircraft?	Clarity of This Image	Usefulness of This Image for Deicing	IceHawk Complete	FE Inspection of A/C	Did FE Require Additional Deicing?	User Comments (E.g., Ease of Use, Recommended Improvements, Factors Affecting System Performance, Discrepancies Noted, Etc.)
		1 (WORST) – 5 (BEST)					
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Here	<input type="checkbox"/> Here	<input type="checkbox"/> Yes <input type="checkbox"/> No	

ICE DETECTION SYSTEM MAINTENANCE LOG

Month/Year: _____

Repair

If repairs are required, contact Ken Wright at (856) 667-6770, x125, as soon as possible.

1. Did the IceHawk require any repairs this month? Yes/No

a. If "Yes," describe the cause: _____

b. If "Yes," describe corrective actions taken: _____

c. If "Yes," what can be done to prevent recurrence? _____

Maintenance

2. Was any maintenance (e.g., cleaning, tighten mounts) performed on the IceHawk or flow meter? Yes/No

If "Yes," describe the maintenance performed: _____

Additional Comments

Please provide any additional comments regarding the Ice Detection System in the space below or on additional pages, as necessary. Comments could include your thoughts on: ease of use, convenience of mounting location, positive or negative impact on deicing operations, or tips for effective use.

DE-ICE/GLYCOL REQUEST FORM

Control number: _____ MCN: _____
Date: _____
Call received by: _____
Time call received by: _____ Requested de-ice time: _____ Launch time: _____
Organization: _____ A/C type: _____ Side number: _____
Requester (name/rate): _____ Location (Spot #): _____
Mission type (SAR, Operational, NALO, Train, FCF, Etc.): _____ Priority: I II III IV

AIRCRAFT/USAGE INFORMATION

Boom operator (name/rate): _____
Was aircraft ready: Yes ☐ No ☐ Wings swept: Yes ☐ No ☐ SE clear of aircraft: Yes ☐ No ☐
Areas de-iced: Nose ☐ Fuselage ☐ Wings ☐ Props ☐ Tail ☐ Other _____

FLIGHT ENGINEER RELEASE

Flight Engineer signature: _____ Flight Engineer name (print): _____
Flight Engineer comments: _____

(Continue on back if required)

DE-ICE/USAGE INFORMATION

Driver: _____ Truck #: _____
Time departed: _____ Time arrived A/C: _____ Temperature: _____ Wind speed (knots): _____
Weather cond: Clear ☐ Freezing fog/drizzle ☐ Light freezing rain ☐ Light snow ☐ Heavy snow ☐
De-ice started: _____ De-ice completed: _____
Glycol % setting: _____ Water used: _____ Glycol used: _____
Comments/problems: _____

(Continue on back if required)

SERVICING INFORMATION

Meters finished: _____
Meters started: _____ Total: _____
Fluids REPLENISHED: Glycol: _____ gal. Water: _____ gal. Diesel: _____ gal. Oil: _____ qt.
De-ice truck RFU: Yes ☐ No ☐ Time servicing completed: _____
Comments/discrepancies: _____

Name/rate: _____ Signature: _____ Observer: _____

CANCELLATION

Canceled by (Name/rate): _____ Phone #: _____ Time: _____

PC Supervisor: _____ Leading Chief: _____ Division Officer: _____ AZ: _____ (File)

Enclosure (3)

